

Mech 424: Advanced Dynamics

<i>Course Description:</i>	The course will cover the kinematics and dynamics of rigid body motion, Lagrangian and Hamiltonian formulations of mechanics and apply them to engineering applications. It will also review particle kinematics and dynamics, as well as 3-D mechanics and gyroscopic motion.
<i>Meeting Time:</i>	12:00-12:50 PM, Monday, Wednesday, Friday Room: Stadium 1204 and Synchronously and Asynchronously Online via Echo 360/Teams
<i>Instructor:</i>	Doug Fankell, Ph.D. Mechanical Engineering Assistant Professor of Practice Office: A103L Email: dfankell@colostate.edu Office Hours: TBD
<i>Prerequisites:</i>	Mech 324: Dynamics of Machines
<i>Required Textbook:</i>	Donald T. Greenwood, <u>Advanced Dynamics</u> , Cambridge Publishing

Course information and announcements will be posted on the Canvas course website. Please check the Canvas site and your email each weekday.

Lectures, Projects, and Homeworks

Lectures: Lectures will be offered both in person and online via the Echo 360 and/or Microsoft Teams platforms.

For those not attending in-person class. The lectures will be live streamed via Echo 360, and recordings posted. It is expected that you view the posting within 24 hours if you do not attend live. **If possible, please attend class at the scheduled time as it will allow for greater interaction with me and the class.**

Homework: Homework will be assigned throughout the semester. Homework solutions will be provided after the homework due date.

Quizzes: Quizzes may be assigned over the course of the semester, if assigned you will have 24 hours to complete the timed (likely 30 mins) quiz. They will be assigned via Canvas.

Projects: Over the course of the semester several "long homeworks" called projects will be assigned. These projects will typically involve writing computer code and additional analysis.

Grading

The course grade will be determined via the following outline.

Table 1: Course Grading

Item	Percentage of Final Grade
Homework and Quizzes	40%
Projects	60%

Grading for each assignment will be determined via the following process 60% credit for major concepts (applying the correct principles), 30% credit for correct application of the concepts (e.g. writing valid equation), 10% for detailed solution (determining the correct answers).

A general breakdown for the grades is as follows, these values may be curved lower, but will never be curved higher. *Meaning if you get a 91% in the class you are guaranteed an A-, but you may get and A depending on the class performance.* Final grades will be rounded up to the nearest whole percentage.

Table 2: Grade Breakdown

Grade	A	A-	B+	B	B-	C+	C	D	F
% >=	93	90	87	83	80	77	70	60	<60

Class Policies

Late work will not be excepted unless in an extenuating circumstance after conference with, substantiation, and approval of the instructor. Things happen, keep me in the loop **BEFORE the due date.**

All work is expected to be clear and organized to generally excepted engineering standards. This includes neatness, grammar, spelling, and work free of mathematical errors. I have worked for several engineering firms and for each one, clear writing is essential and was emphasized as an important skill. **You will lose points for unprofessional work or be asked to redo it.** Credit will never be given for answers only, you must back up your answer with work and units must always be shown.

Email Expectations

To respect both the students' and my time, I check my email two or three times a day during working hours, usually once in the morning and once in the afternoon. I will do my best to respond as quickly as possible, but do not expect an immediate response and do not expect a response outside of working hours. This means that if you email me at 11PM the day before something is due, you will likely not get a response until after the due date. This also means I will not send out an email at 11PM with the expectation that you have read it by 9AM the next morning. I do expect you to check your email daily. Additionally, I expect all emails to be written professionally, with aptly titled subject lines, clear, concise, and to-the-point language. Please contact me with any additional questions.

A Note on Note Taking

While I recognize many of you will choose to take notes electronically, I highly encourage the "old-fashioned" method of notetaking, as it been shown [in several studies](#) that handwriting notes results in better retention and higher creative problem solving ability. While taking notes, do not try and write verbatim what I am saying or presenting, but instead try and grab onto certain "nuggets" that will reinforce what you are listening to and watching. Check out [this video](#) for ideas on how to take notes better.

Grading Questions

Questions on grading and grading errors will be considered up to ONE WEEK after they are returned. Please meet with me or send me an email with a formal written memo describing your question or the grading error within the one week deadline.

In Course and Online Conduct

Whether attending class, labs, and office hours in person or online. You are expected to conduct yourself in a professional manner. This means arriving on time, removing distractions, e.g. remaining off your cell-phone, muting your microphone unless speaking, being respectful of class-mates etc. If attending online, please use the chat or hand-raising feature if you have questions.

If you ever feel you are being harassed or discriminated against for any reason in class or at CSU please reach out to me or the Office of Equal Opportunity. We will do everything in our power to address this issue.

For guidelines on what constitutes professional behavior please consult the **Colorado State University General Catalog Academic Integrity Policy, Student Conduct Code** and the **Mechanical Engineering Student Academic Integrity Policy**.

Academic Honesty

This course will adhere to the Colorado State University General Catalog Academic Integrity Policy and Student Conduct Code and the Mechanical Engineering Student Academic Integrity Policy. Please Review. Cheating and the copying of another's work is not tolerated and can result in loss of exam/assignment credit, course failure and dismissal from the university.

Special Needs

CSU strives for an inclusive learning environment. If you anticipate or experience any barriers related to the format or requirements of this course please contact the Student Disability Center, TILT Building, room 121; (970) 491-6385, disabilitycenter@colostate.edu.

If you are a student who will need accommodations in this class due to a disability or chronic health condition, I will need an accommodation letter from the Student Disability Center (SDC) before they are implemented. Please meet with me during my office hours to give me the letter and/or to further discuss your needs.

Need Help

CSU is a community that cares for you. If you are struggling with drugs or alcohol, and/or experiencing depression, anxiety, overwhelming stress or thoughts of hurting yourself or others please know there is help available. Counseling Services has trained professionals who can help. Contact 970-491-6053 or go to <http://health.colostate.edu/> If you are concerned about a friend or peer tell someone by calling 970-491-1350 to discuss your concerns with a professional who can discreetly connect the distressed individual with the proper resources (<http://supportandsafety.colostate.edu/tellsomeone>). Rams take care of Rams. Reach out and ask for help if you or someone you know is having a difficult time.

Tentative Schedule

Week	Date	Monday	Wednesday	Friday
1	18-Jan	MLK DAY	Due: Shaun Achor Ted Talk Lecture 01: Course Policies/Intro/Positivity Assign: Meet with the Prof.	Lecture 02: Review Kinematics Assign: HW1 Ch 2
2	25-Jan	Lecture 03: Particle Kinematics	Lecture 04: Particle Dynamics 1	Due: Meet with the Prof. Lecture 05: Particle Dynamics 2
3	1-Feb	Due: HW 1 Lecture 06: Particle Dynamics 3 Assign: Project 1; Matlab KM/DM	Lecture 07: Particle Dynamics 4 Assign: HW2 Particle Dynamics	Lecture 08: Particle Dynamics 5 Momentum
4	8-Feb	Lecture 09: Particle Dynamics 6 Work	Lecture 10: Particle Dynamics 7 Energy	Due: HW2 Lecture 11: Particle Dynamics 8
5	15-Feb	Lecture 12: System of Particles 1 Dynamics	Lecture 13: System of Particles 2 Work/Energy	Lecture 14: System of Particles 3 I and M
6	22-Feb	Due: Project 1 Lecture 15: System of Particles 4 Mass Change Assign: Project 2, Particle Systems	Lecture 16: System of Particles 3 H/HC	Lecture 17: System of Particles 6 Assign: HW3 V.W.
7	29-Feb	Lecture 18: Virtual Work 1	Lecture 19: Virtual Work 2	Due: HW3 Lecture 20: Virtual Work 3 Assign: HW 4 Lagrange
8	7-Mar	Due: Project 2 Lecture 21: Lagrange Eq. 1 General Assign: Project 3, Lagrange	Lecture 22: Lagrange Eq. 2 Constraints	Lecture 23: Lagrange Eq. 3 Numerical 1
9	14-Mar	Lecture 24: Lagrange Eq. 4 Numerical 2	Lecture 25: Lagrange Eq. 5	Due: HW 4 Lecture 26: Lagrange Eq. 6
10	21-Mar	Lecture 27: Lagrange Eq. 7	Lecture 28: Lagrange Eq. 7	Lecture 25. Lagrange Eq. 8
11	28-Mar	Due: Project 3 Lecture 30: Kinematics and Kinetics 1 Assign: Project 5 Kinematics and Kinetics	Lecture 31: Kinematics and Kinetics 2	Lecture 32: Kinematics and Kinetics 3 Assign: HW 5 Kinematics and Kinetics
12	4-Apr	Lecture 33: Kinematic and Kinetics 4	Lecture 34: Kinematic and Kinetics 5	Due: HW 5 Lecture 35: Recap
13	11-Apr	Spring Break		
14	18-Apr	Due: Project 3 Lecture 36: Euler angles Assign: Project 6: Numerical Methods	Lecture 37: Euler Equations	Lecture 38: Numerical Methods 1 Assign: HW 6 Euler
15	25-Apr	Lecture 39: Numerical Methods 2	Lecture 40: Numerical Methods 3	Due: HW6 Lecture 41: Numerical Methods 4
16	2-May	Lecture 42: Numerical Methods 5	Lecture 43: Numerical Methods 6	Due: Project 6 Lecture 44: Numerical Methods 7
17	9-May	Finals Week: Turn in any project rework		

*Subject to change based on the instructors discretion